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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/748,734	12/30/2003	Ken Nakahara	88519.0001	7543

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EXAMINER	
MONDT, JOHANNES P	
ART UNIT	PAPER NUMBER
3663	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/09/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/748,734	NAKAHARA, KEN	
	Examiner	Art Unit	
	Johannes P. Mondt	3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 November 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4-6,8-11,13-15 and 17-19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *4-6,8-11,13-15 and 17-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response filed 11/16/06 supplemented by Supplementary Response filed 1/30/07 forms the basis for this office action.

Applicant was notified on 1/29/07 that the claim list in Response filed 11/16/06 is incorrect: claim 1 should have been listed as "Cancelled"; see Amendment filed 7/28/06 by which claim 1 was cancelled. Applicant submitted on 2/2/07 a Supplementary Response correcting the incorrect status of claim 1, which herewith has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. ***Claim 4, 6, 10, 11, 13-15 and 19*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kadota (US 2002/0126719 A1) in view of Ishizaki (WO 02/89223) (national stage Ishizaki (US 2005/0224825 A1) serves in this office action as translation) (all as previously cited).

Kadota teaches a transparent electrode (Figure 4, title, abstract, pages 1-3, especially [0035]-[0038]) (N.B.: ZnO is inherently transparent to light, as admitted by applicant in his specification) comprising:

a ZnO layer 43 ([0035] and Figure 4) (N.B.: said ZnO layer is a low resistivity layer and abuts electrode 49 (Figure 4 and [0035]);

wherein the ZnO layer 43 is formed on a semiconductor layer 44/45/46/47/48 ([0035]), and wherein the semiconductor layer comprises a GaN system semiconductor (loc.cit.).

Kadota does not necessarily teach the limitation "an Mg-doped ZnO film formed on the ZnO layer" as recited in claim 4.

However, it would have been obvious to include said limitation in view of *Ishizaki*, who, in a patent document on a production method for a light-emitting element, hence analogous art, teaches the application of MgZnO as buffer layer abutting sapphire substrate. It would have been obvious to insert a MgZnO layer between the ZnO layer and the sapphire layer in Kadota because the lattice constant of ZnO is 5.19 A (Table 5.5 in Wasa et al), that of (c-plane) sapphire is 4.76 A (see, e.g., Murakami, col. 5, l. 4-6) , of GaN 5.12. A (Sze), while that of MgO is less than that of ZnO (cf. Narayan et al, col. 10, l. 35-42), and hence doping with Mg of ZnO enables improved matching of the lattice constants of sapphire and ZnO through a buffer layer. *Motivation* to include the teaching by Ishizaki in the invention stems from the goal of Kadota to have buffer action between the members of the stack and the sapphire substrate: in fact, layer 43 is not only a low-resistivity layer abutting electrode 49 (and hence comprised in said electrode), it is also explicitly a buffer layer between the GaN stack and the c-plane sapphire layer ([0035]). However, as shown from the values of the lattice constants of GaN, ZnO and c-plane sapphire the buffer is not perfect and can be improved by inserting an Mg-doped ZnO layer, i.e., a MgZnO layer, between the ZnO buffer layer and the sapphire substrate that acts as a buffer between the ZnO buffer and the

sapphire substrate, further improving lattice matching. *Motivation* to include the teaching by Ishizaki in the invention by Kadota derives from the further improvement of lattice matching. The examiner takes official notice that lattice matching improves light efficiency. *Combination* of the teaching of a MgZnO buffer layer abutting the sapphire substrate merely requires the insertion of a layer in a layer stack and achieves meeting the claim because the Mg-doped ZnO layer is located on the ZnO layer when the positive vertical once and for all is defined to point down, while in the same coordinate system the ZnO layer is located on said semiconductor substrate. It is finally noted that a replacement of the ZnO buffer layer with a MgZnO buffer layer would not necessarily achieve the same improvement because the lattice mismatch at the interface with the GaN semiconductor layer would deteriorate.

Finally, it is noted that the wording "formed" (lines 4, 5) has patentable weight only in as much as "formed" can be replaced by "located": The limitation "formed" is only of patentable weight in as much as the method steps of formation distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new

method is not a patentable product, whether claimed in "product by process" claims or not.

On claim 6: the Mg-doped ZnO film of the combined invention is located to overlie an upper layer of the ZnO layer (namely: the Mg-doped layer is in between the sapphire substrate and the ZnO buffer layer (Figure 4), keeping in mind the definition of the positive vertical axis as pointing down, as defined in the discussion of claim 4.

On claim 10: the Mg-doped ZnO film 7 covers a portion of a side surface of the electrode. The latter would otherwise be more exposed to the environment. Therefore, the Mg-doped ZnO film 7 has the *capacity* to improve acid resistance of the transparent electrode. Furthermore, in reference to the claim language referring to "improves acid resistance of the transparent electrode", intended use, in this case the use as a protection against acids, and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963).

On claim 11: the semiconductor layer 48/47/46/45/44 is located on a substrate 50 ([0035]-[0036]).

On claim 13: in the combined invention discussed under claim 4 the discussion of which is included herein by reference, the light-emitting device comprises a semiconductor layer 48/47/46/45/44 formed on a substrate 50; a ZnO transparent electrode 43 formed on the semiconductor layer (again the same coordinate system is

included wherein the positive vertical points down), and a Mg-doped ZnO film formed on the ZnO transparent electrode, wherein the semiconductor layer comprises a GaN system semiconductor layer 48/47/46/45/44 (or any single one of 44, 45, 46, 47, an 48).

On claim 14: in the combined invention discussed under claim 4 the discussion of which is included herein by reference, the light-emitting device comprises a semiconductor layer 48/47/46/45/44 formed on a substrate 50; a ZnO transparent electrode 43 formed on the semiconductor layer (again the same coordinate system is included wherein the positive vertical points down), and a Mg-doped ZnO film formed on the ZnO transparent electrode, wherein the semiconductor layer comprises a GaN system semiconductor layer 48/47/46/45/44 (or any single one of 44, 45, 46, 47, an 48).

Furthermore, the semiconductor layer comprises an p-type GaN system semiconductor layer 48 formed on a substrate 50, an emission layer 46 formed on the n-type GaN system semiconductor layer, and a n-type GaN system semiconductor layer (44, 45 or 44/45) formed on the emission layer (cf. [0035]-[0036] and Figure 4).

On claim 15: the Mg-doped ZnO film of the combined invention is located to overlie an upper layer of the ZnO layer (namely: the Mg-doped layer is in between the sapphire substrate and the ZnO buffer layer (Figure 4), keeping in mind the definition of the positive vertical axis as pointing down, as defined in the discussion of claim 4.

On claim 19: the Mg-doped ZnO film 7 covers a portion of a side surface of the electrode. The latter would otherwise be more exposed to the environment. Therefore, the Mg-doped ZnO film 7 has the *capacity* to improve acid resistance of the transparent electrode. Furthermore, in reference to the claim language referring to "improves acid

resistance of the transparent electrode", intended use, in this case the use as a protection against acids, and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963).

2. ***Claim 5*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Kadota (US 2002/0126719 A1) in view of Ishizaki (WO 02/89223) (national stage Ishizaki (US 2005/0224825 A1)) and Shakuda (6,084,899). As above, the national stage serves as translation for Ishizaki as cited. All were previously cited.

Kadota teaches a transparent electrode (Figure 4, title, abstract, pages 1-3, especially [0035]-[0038]) (N.B.: ZnO is inherently transparent to light, as admitted by applicant in his specification) comprising:

a ZnO layer 43 ([0035] and Figure 4) (N.B.: said ZnO layer is a low resistivity layer and abuts electrode 49 (Figure 4 and [0035]);

wherein the ZnO layer 43 is formed on a semiconductor layer 44/45/46/47/48 ([0035]), wherein the semiconductor layer comprises a GaN system semiconductor (loc.cit.), and

wherein the semiconductor layer comprises an p-type GaN system semiconductor layer 48 formed on a substrate 50, an emission layer 46 formed on the

n-type GaN system semiconductor layer, and a n-type GaN system semiconductor layer (44, 45 or 44/45) formed on the emission layer (cf. [0035]-[0036] and Figure 4).

Kadota does not necessarily teach (a) the limitation "an Mg-doped ZnO film formed on the ZnO layer" as recited in claim 4; (b) said layers 48 and (44, 45, or 44/45) to be n-type and p-type, respectively.

However, it would have been obvious to include said limitation ad (a) in view of *Ishizaki*, who, in a patent document on a production method for a light-emitting element, hence analogous art, teaches the application of MgZnO as buffer layer abutting sapphire substrate. It would have been obvious to insert a MgZnO layer between the ZnO layer and the sapphire layer in Kadota because the lattice constant of ZnO is 5.19 A (see Wasa et al, Table 5.5), that of (c-plane) sapphire is 4.758 A (see e.g., Murakami, col. 5, l. 1-4), of GaN 5.12. A (Sze), while that of MgO is less than that of ZnO (cf. Narayan et al, col. 10, l. 35-42), and hence doping with Mg of ZnO enables improved matching of the lattice constants of sapphire and ZnO through a buffer layer. *Motivation* to include the teaching by Ishizaki in the invention stems from the goal of Kadota to have buffer action between the members of the stack and the sapphire substrate: in fact, layer 43 is not only a low-resistivity layer abutting electrode 49 (and hence comprised in said electrode), it is also explicitly a buffer layer between the GaN stack and the c-plane sapphire layer ([0035]). However, as shown from the values of the lattice constants of GaN, ZnO and c-plane sapphire the buffer is not perfect and can be improved by inserting an Mg-doped ZnO layer, i.e., a MgZnO layer, between the ZnO buffer layer and the sapphire substrate that acts as a buffer between the ZnO buffer and

the sapphire substrate, further improving lattice matching. *Motivation* to include the teaching by Ishizaki in the invention by Kadota derives from the further improvement of lattice matching. The examiner takes official notice that lattice matching improves light efficiency. *Combination* of the teaching of a MgZnO buffer layer abutting the sapphire substrate merely requires the insertion of a layer in a layer stack and achieves meeting the claim because the Mg-doped ZnO layer is located on the ZnO layer when the positive vertical once and for all is defined to point down, while in the same coordinate system the ZnO layer is located on said semiconductor substrate. It is finally noted that a replacement of the ZnO buffer layer with a MgZnO buffer layer would not necessarily achieve the same improvement because the lattice mismatch at the interface with the GaN semiconductor layer would deteriorate.

Furthermore, it would have been obvious to include said limitation ad (b) in view of Shakuda, who teaches interchangeability of p-type and n-type conductivity layers in a GaN-system semiconductor layer for a light-emitting device (col. 23, l. 50-60), from which the vertical order of p-type and n-type layers in said stack is seen to be a mere design choice.

Finally, it is noted that the wording "formed" (lines 3-4 and 6-8) has patentable weight only in as much as "formed" can be replaced by "located": The limitation "formed" is only of patentable weight in as much as the method steps of formation distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ

324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

3. ***Claims 8-9 and 17-18*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Kadota and Ishizaki as applied to claim 13 above, and further in view of Gibb et al (6,787,435 B2). All were previously cited.

As detailed above, claims 4 and 13 are unpatentable over Kadota in view of Ishizaki. *Neither Kadota nor Ishizaki necessarily teach* the further limitation defined by claims 8-9 or 17-18. *However, it would have been obvious to include said further limitations in view of Gibb et al, who, in a patent on a GaN system semiconductor layer based light-emitting device, hence analogous art,* teach a first metal pattern (metal stack 40))[0041]) for providing backside metallization and second metal pattern (solder pattern 44 ([0029]) to be formed on the semiconductor layer (same coordinate system is again adopted, with positive vertical coordinate increasing downward) so as to provide a suitable surface for providing heat sink or lead frame support. *Motivation* to include the teaching by Gibb et al stems directly from said teaching by Gibb et al of the backside metallization and solder pattern for support.

Response to Arguments

Applicant's arguments filed 11/16/06 (Remarks) have been fully considered but they are not fully persuasive:

(1) Arguments in traverse of the rejection under 35 U.S.C. 112, first paragraph, in conjunction with the necessarily conductive nature of the Mg:ZnO film, both intrinsically because of its material composition and in order that contact 13 can be what is ordinarily understood to be the function of a contact in the electrical arts.

(2) However, with regard to the art rejections, counter to applicant's narrow interpretation of the word "on", "on" means a variety of different location indicators, as exemplified by, for instance, Merriam-Webster's Collegiate Dictionary, tenth Edition, page 811, such as indicating position in or in contact with an outer surface, or indicator of close proximity, see meanings 1-b and 1-c in Merriam-Webster's; while, even *arguendo*, "on" as indicator of a position in or in contact with and supported by a top surface, i.e., meaning "1 a" in Merriam-Webster's Collegiate Dictionary, what constitutes "top surface" only has a limiting meaning in the presence of an independent definition either implicit or explicit of what is taken to be the positive vertical axis. In the underlying case, the claim language does not contain said definition. Therefore, counter to applicant's allegation that Kadota "illustrates layers 44/45/46/47/48 being formed on the ZnO layer 43, and not the other way around" (page 8 of Remarks) is not persuasive. Accordingly the art rejections stand.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JPM
February 4, 2007

Primary Patent Examiner:
Johannes Mondt (Art Unit: 3663)